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(54) Abstract Title

Cover tape for an electronic component carrier

(57) A composite cover tape 2 for an electronic component carrier 6, includes a uniaxially extended layer 22, and an adhesive layer 24 for adhering the cover tape to the carrier, wherein a portion of the tape that is not adhered to the carrier can be torn away to provide access to the components. The cover tape may include a release coating 21, an antistatic layer 23, or a printing layer (not shown). The uniaxially extended layer allows removal of the torn portion without excessive vibration.

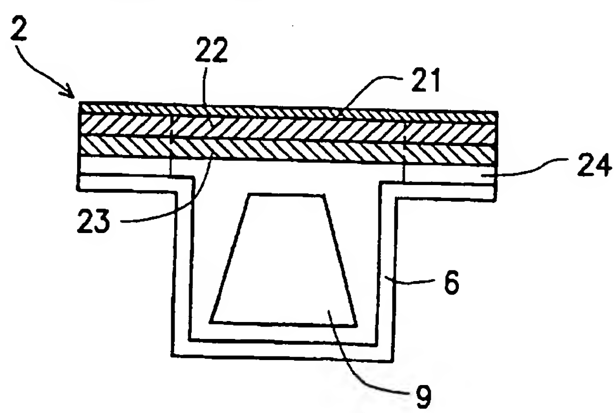

FIG. 9

GB 2 346 128 A

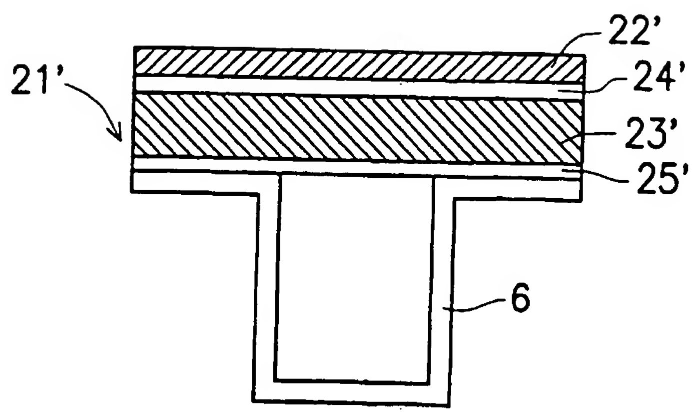

FIG. 1-1 (PRIOR ART)

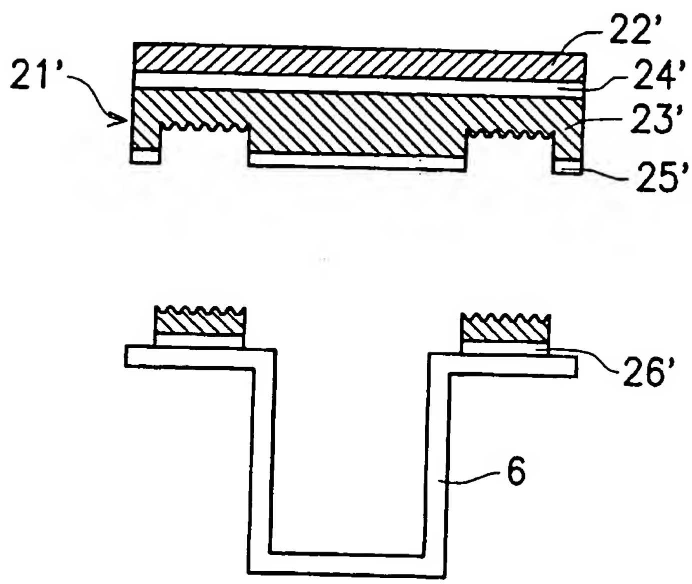

FIG. 1-2 (PRIOR ART)

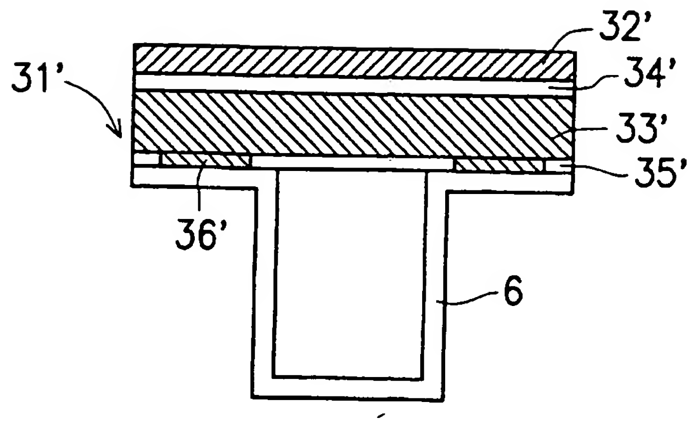

FIG. 2-1 (PRIOR ART)

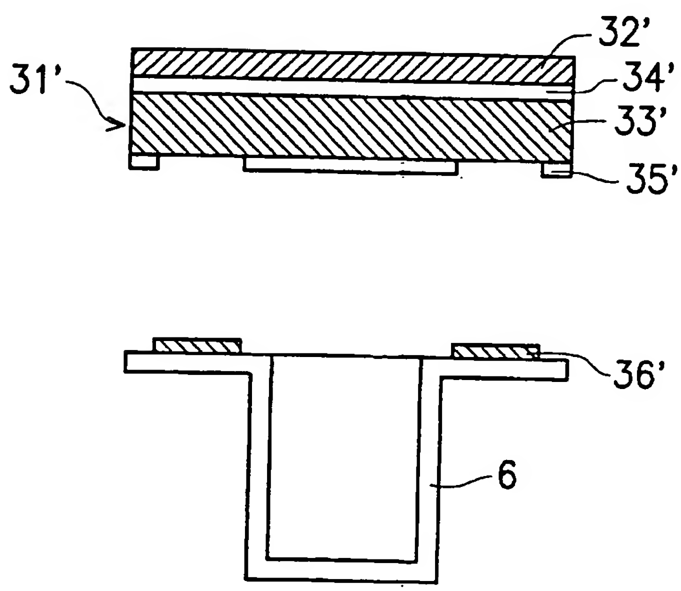

FIG. 2-2 (PRIOR ART)

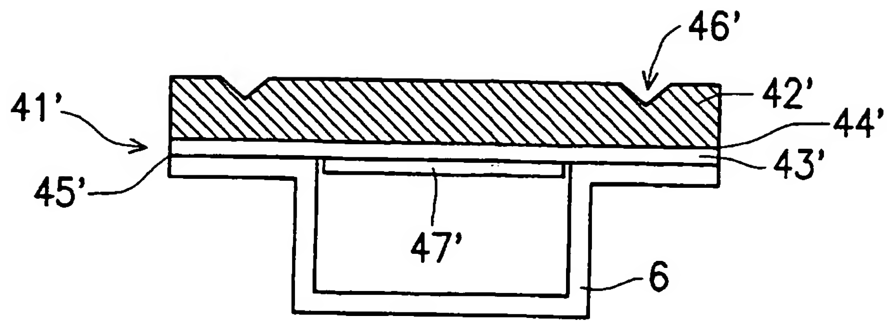

FIG. 3 (PRIOR ART)

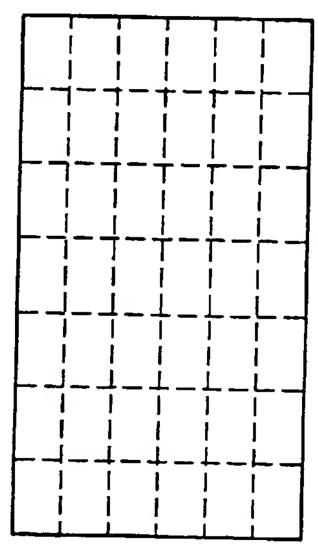

FIG. 4 (PRIOR ART)

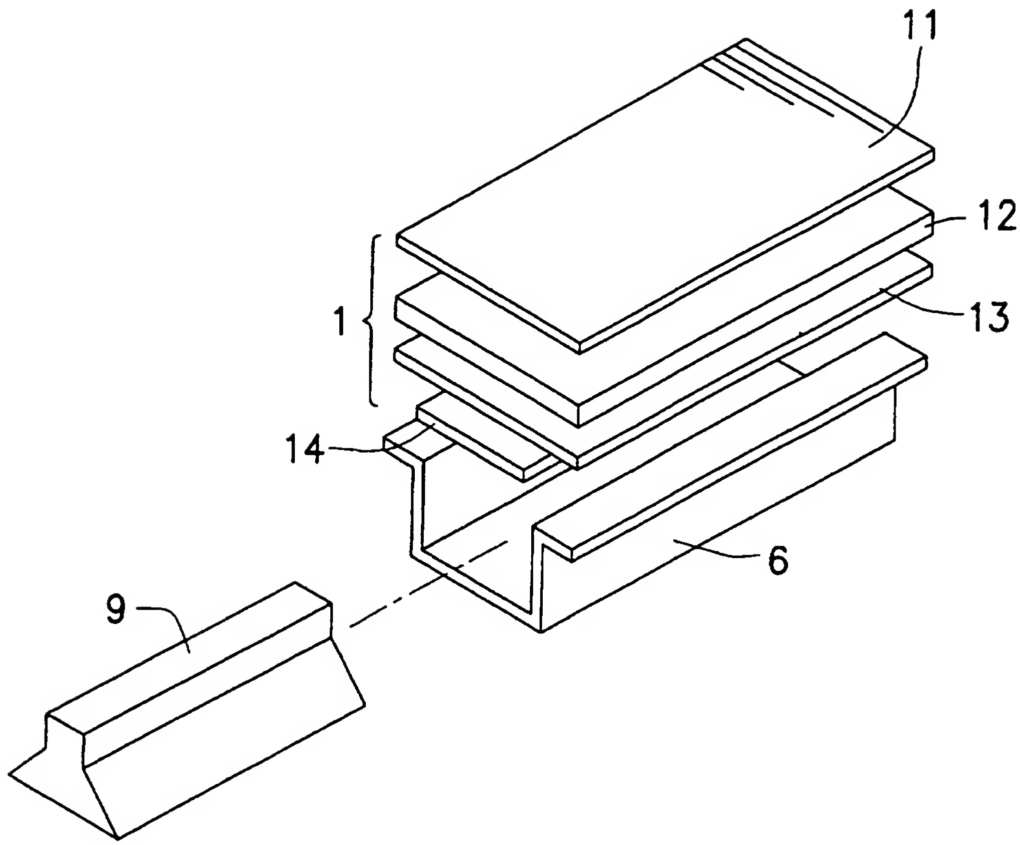

FIG. 5

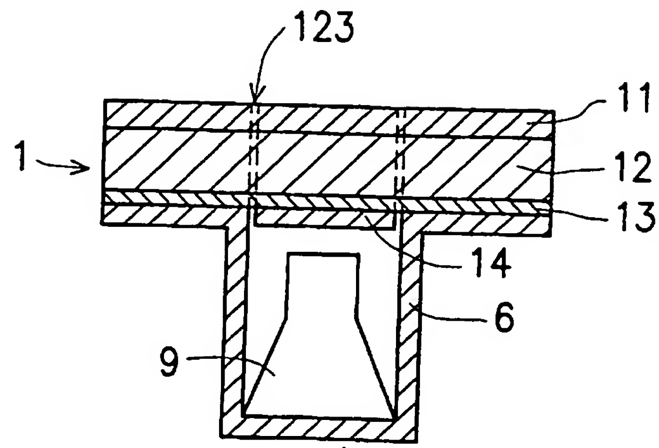

FIG. 6-1

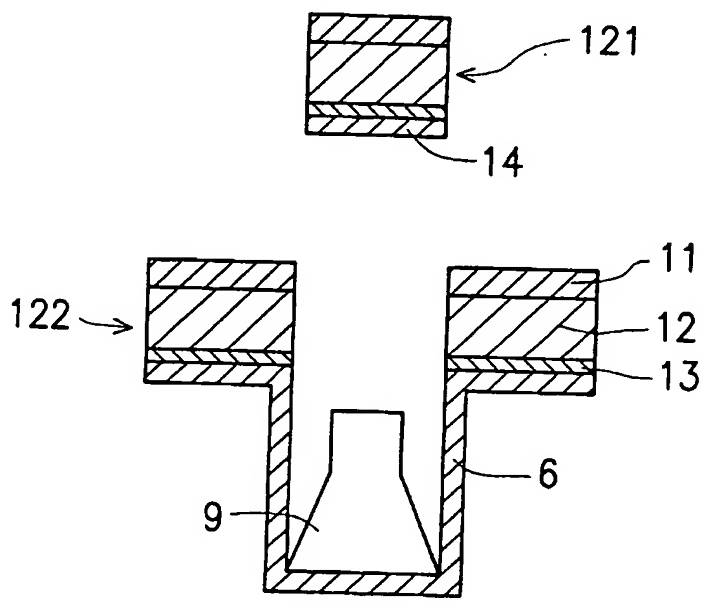

FIG. 6-2

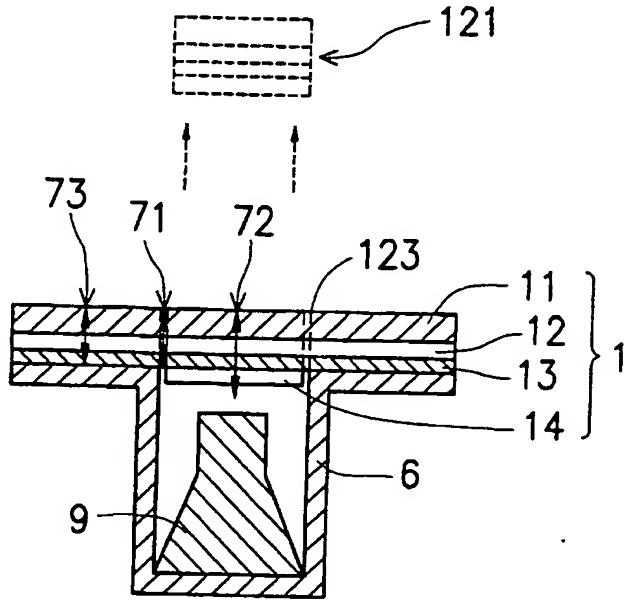

FIG. 7

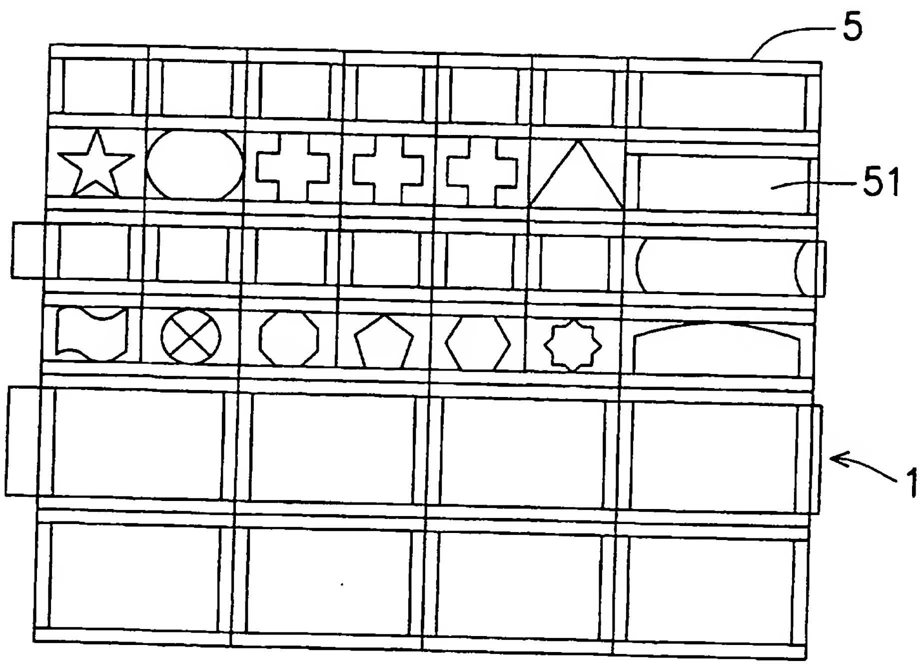

FIG. 8

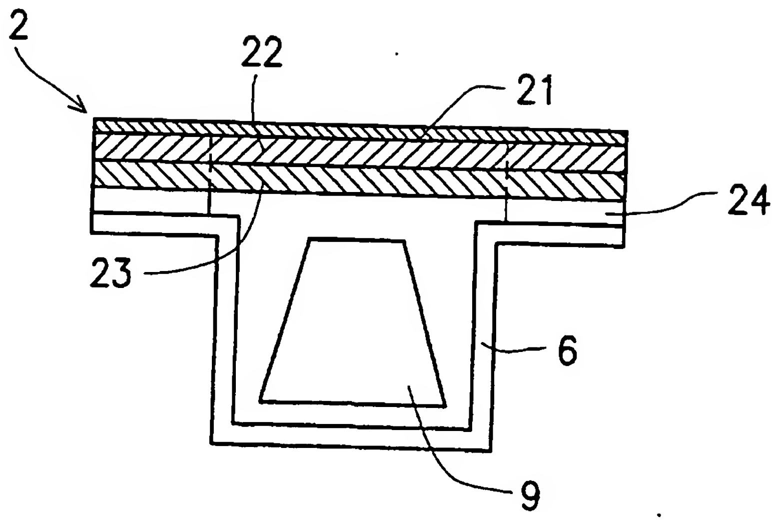

FIG. 9

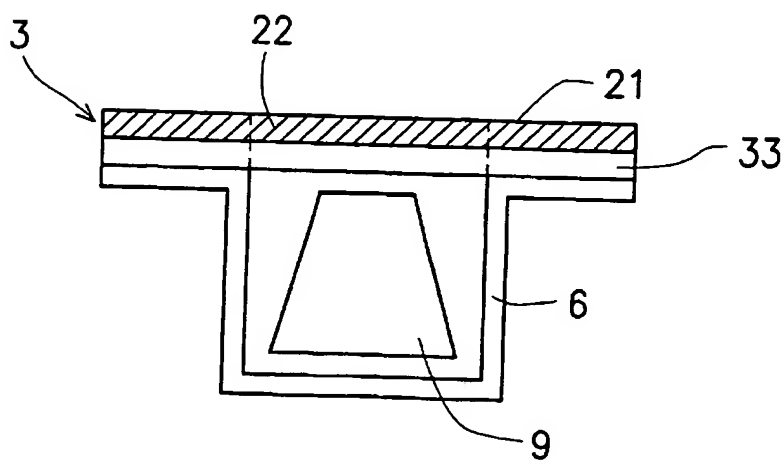

FIG. 10

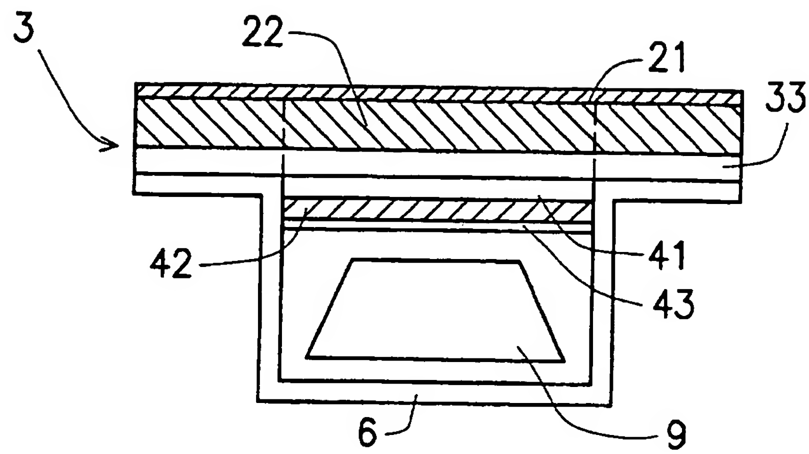

FIG. 11

COVER TAPE FOR PACKAGING

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates in general to a cover tape for packaging and more particularly to a cover tape for packaging electronic parts or other devices incorporated with carrier concavities or carrier trays.

Description of the Related Art

A previous method for packaging electronic parts is using carrier concavities molded from plastics incorporated with a cover film to package the electronic parts. This method is aimed to provide simple protection for storage and shipping. With the tendency of more automatic industrial instruments and the requirement of higher yield, a packaging method with a tape-like structure is developed, which extends the idea of single carrier concavities to become a carrier tape with a number of carrier concavities so as to increase the efficiency. In U.S. patent no. 4724958, a tape-like electronic component package is disclosed, wherein the electronic parts are placed in the tape-like structure with a number of concavities. Moreover, in U.S. patent no. 4963405, it is disclosed that a tape for encasing electronic parts comprising a carrier tape having a number of recesses for encasing electronic parts and a number of guide perforations, and a cover tape pasted onto said carrier tape with an adhesive so as to seal only said recesses while leaving the guide perforations open. This method is now most commonly used.

Recently, chip type electronic parts used for surface mounting are commonly supplied by being contained in a tape-like package consisting of a carrier tape having a number of recesses for encasing chip type electronic parts and a cover tape sealed to the carrier tape. The electronic parts contained in the tape-like package are automatically taken out after peeling the cover tape off the tape-like package, and are mounted on the surface of an electronic circuit substrate. In actual practice, the cover tape is coated or adhered with an adhesive layer adapted for fastening to the border area of the carrier tape. The material of the adhesive layer can be selected from the group consisting of the pressure sensitive adhesives and the heat sealable thermoplastics. The adhesive layer must provide proper adhesion strength so that the cover tape can be firmly bonded to the carrier tape, and then can be also smoothly peeled off from the carrier tape for permitting the encased electronic parts to be taken out from the carrier tape. However, it is not easy to have an adhesive layer between the cover tape and the carrier tape providing adequate adhesion strength and a low peeling-off strength simultaneously, because both factors are usually work against each other. Excessively high or low adhesion strength or uneven adhesion strength may cause certain problems. For example, when the adhesion strength is excessively low, the sealed cover tape may be separated from the carrier tape due to the unexpected minor bumping at the time of the package transfer, and the encased electronic components may drop off. When the adhesion strength is excessively high, the much higher force must be applied to the cover tape to peel it off from the carrier tape, thereby causing a step motion and a subsequently vibration problem. When the vibration occurs, encased electronic components may be forced to jump out of the carrier tape. More particularly, surface-mounted electronic components such as liquid crystal display chips, diodes, passive components including resistors, conductors, and capacitors, and active

components including integrated circuit, etc., have come to be made in chips of higher capability and smaller size. Minor vibration may cause the small electronic components to jump out from the carrier tape. If adhesion strength is not uniformly distributed, the both aforesaid problems may occur when peeling off the cover tape from the carrier tape. In order to eliminate the aforesaid problems, there are limitations on material selection of the cover tape and the fabrication of the cover tape. Sealing temperature, sealing pressure and sealing speed must be taken into account if the cover tape is made of the heat sealable adhesives or thermoplastics when bonding the cover tape to the carrier tape. The sealing of the cover tape to the carrier tape also has a great concern with the setting time of the thermoplastics because of their thermal properties. Generally, a faster sealing process requires a relatively higher sealing temperature, and the material must have a relatively higher coefficient of heat conductivity or shorter setting time. However, polymer is basically a good heat insulating matter. This poor heat conductive property is contrary to the short setting time requirement. If there is to add an additive having a relatively higher heat conductivity, other negative effects such as an opaque feature due to the light scattering from the different phase domains may occur. All these factors affect the development of the candidate materials. It is indeed a challenge to develop an adhesive layer material for the cover tape that provides the suitable adhesion strength, achieves satisfactory packaging effect, and is also suitable for use in different processing conditions. Further, when peeling off the cover tape from the carrier tape, the unexpected abnormal peeling-off effects such as creaking in the unexpected direction must be avoided. These abnormal defects may cause the cover tape to split or break at the improper locations, or to have a part remained and covered on the recesses of the carrier tape. All these conditions affect the manufacturing process and productivity.

Figures 1-1 and 1-2 show a cover tape sealed to a carrier tape to encase chip type electronic parts according to the U.S. Pat. No. 5,208,103. The cover tape 21' includes a biaxially oriented film 22', an intermediate layer 23', a first adhesive layer 24' sealed between the biaxially oriented film 22' and the intermediate layer 23', and a second adhesive layer 25' laminated between the intermediate layer 23' and the carrier tape 6. The cover tape 21' is specifically designed so that the intermediate layer 23' has a weaker cohesive strength. When the cover tape 21' is heat-sealed to the carrier tape 6, a heat-sealed portion 26' is formed in the cover tape 21', and the adhesion force of the heat-sealed portion 26' is greater than the cohesive strength of the intermediate layer 23' when the cover tape 21' is peeled off from the carrier tape 6. Therefore, the peeled-off interface is within the intermediate layer 23', and the peeling force required is about 10-120 grams per bonded millimeter. However, when the cover tape 21' is peeled off after it has been bonded to the carrier tape 6, the peeling direction of the cover tape 21' has a concern with the peeling force, the peeling angle and direction, the peeling speed, and the heat-sealed portion 26'. Therefore, the peeling direction may be affected by the aforesaid factors to cause an improper peeling, for example, the cover tape 21' may be peeled off from the carrier tape 6 at an angle to the machine direction or at an angle to the bonding line, causing the cover tape 21' to break improperly or the manufacturing process to stop.

Figures 2-1 and 2-2 show a cover tape for packaging electronic chips according to the U.S. Pat. No. 5,346,765. The cover tape 31' includes a biaxially oriented film 32', an intermediate layer 33', a first adhesive layer 34' sealed between the biaxially oriented film 32' and the intermediate layer 33', and a second adhesive layer 35' sealed between the intermediate layer 34' and the carrier tape 6. A heat-sealed portion 36 is formed in the cover tape 31' when the cover tape 31' is heat-sealed to the carrier tape 6, and the

adhesion force of the heat-sealed portion 36' is greater than the adhesion force between the intermediate layer 33' and the second adhesive layer 35' when the cover tape 31' is peeled off from the carrier tape 6. Therefore, the peeled-off interface exists between the intermediate layer 33' and the second adhesive layer 35', and the peeling force required is about 10-120 grams per bonded millimeter, i.e., the adhesion strength of the cover tape 31' to the carrier tape 6 is about 10-120 grams per bonded millimeter. This weak adhesion strength may cause the cover tape 31' to be separated from the carrier tape 6 due to a minor impact during a transfer of the package.

When the aforesaid adhesive layers are designed for heat-sealed packaging, the hot melt elastomers or thermoplastics and their mixed additives when are used for the adhesive layers usually have the potentially reactive functional group or the thermally unstable functional group. Generally, the hot melt block copolymers such as the styrene-isoprene-styrene (SIS), the styrene-butadiene-styrene (SBS) and the butyl rubber (BR), and the blended resins usually have an unsaturated bonding structure. The heat-sealable thermoplastics used to have the additive with the structure featured either a low mechanical modulus or thermally unstable functional group, for example, the thermal unstable functional group of the ester linkage, may be caused to decompose easily by heat. Materials having the unstable functional group, which is unstable due to moisture or heat, tend to be affected by humidity or temperature, or both of them. For example, because of the nature of the hydrogen bonding, the material having the carboxylic function group tends to deteriorate upon the effect of humidity and high temperature. Ethylene-vinyl acetate (EVA) either blending with other material or copolymerizing with the other material having the ester linkage is a functional group sensitive to high temperature and humidity. The aforesaid materials tend to be affected by weather,

storage temperature and humidity. The material properties may change over time, more particularly the speed of material property deterioration is accelerated when under high temperature and high humidity conditions simultaneously, thereby causing the materials to deviate from their application condition and the self life of the materials to be shortened. It is common that the physical properties of the adhesive materials start to deviate from their application range at a certain length of time after the storage of the materials. If the adhesion strength is changed to an excessively low level, the cover tape may be separated from the bonded carrier tape causing the encapsulated parts to drop off from the recesses. On the other hand, if the adhesion strength is changed to an excessively high level, the applied peeling force may not be uniformly distributed over the cover layer when the cover tape is peeled off from the carrier layer. Thereby, it causes the carrier tape to vibrate and a consequent jump-off problem of the sealed parts.

Figure 3 shows another structure of cover tape according to the prior art. The cover tape 41′ comprises a biaxially extended film 42′, an intermediate layer 43′, and a back layer 47′. The biaxially extended film 42′ and the intermediate layer 43′ are bonded together by means of a first adhesive layer 44′. The intermediate layer 43′ is bonded to the carrier tape 6 by a second adhesive layer 45′. The back layer 47′ is bonded to the intermediate layer 43′ by the second adhesive layer 45′. The biaxially extended film 42′ has longitudinal score lines 46′. The cohesive strength along the longitudinal score lines 46′ is the weakest. The longitudinal score lines 46′ can be scored prior to be sealed with the carrier tape 6 or during the sealing process. When the cover tape 41′ is peeled off after it has been bonded to the carrier tape 6 by a heat press, it is torn along the longitudinal score lines 46′. This structure may provide a better adhesion strength to the

carrier tape 6. Unfortunately, a precision scoring process must be employed to cut the biaxially extended film 42′. The application of the precision scoring process requires a cutting tool, a pressure and temperature control system. Because of weak cohesive strength along the scored lines 46′ and the effect of thermal shrinkage of the film, the scored depth of the longitudinal score lines 46′ and the ratio of depth of the scored line 46 and thickness of the film affect actual application of the cover tape 41′. This longitudinally grooved, biaxially extended film 42′ is fragile to impact force and stress build-up due to the effect of thermal shrinkage.

Practically encased objects of either electronic active components or passive components use to be brought together on the printed circuit board. Active components are usually sensitive to the static charge. Static charge impact can easily damage the active components during packaging or transferring. However, static charge impact to impose on the active components may occur via the contact with a charge carried passive component or via the charge induction from the other charge carried components indirectly. Therefore, an antistatic or charge dissipation treatment is needed. In actual practice, it is especially needed for the contact surface between the cover tape 41 and the encasing devices and the outer surface of the package to have the function of antistatic or charge dissipation. This can be achieved by the following methods: (1) incorporating with ionic and non-ionic surfactants by internal blending or external coating, (2) mixing with conductive material, such as carbon black power, graphite fiber powder or metal power and (3) metal vapor deposition or coating material with conductor property such as aluminum vapor deposition or using lacquers with intrinsically conductive polyaniline.

The U.S. Pat. No. 5,441,809 and 5,599,621 describe a cover tape structure for the

surface mounting device packaging that has a peeling force of between 30 and 80 grams per millimeter after heat-sealed to a carrier tape to form a two-piece package for the electronic parts. The cover tape comprises a polymeric film, one side of which is coated with a layer of metal, and a heat sealable adhesive is laminated to the metal-coated side of the film, the adhesive layer comprising thermoplastic elastomer, metal powder or the metal coated particle. Because of the certain characteristics of the material compatibility, phase separation may occur if this blend material is used under the high level of humidity and temperature over the elapsed time. Therefore, the physical property of this adhesive layer, such as the peeling strength, can deviate from within 30-80 grams per millimeter to the improper application range. If the peeling strength is too low, the cover tape can be loosen from the carrier tape during the packaging and processing and the packaged parts can be lost. If the peeling strength is too high, then the carrier tape can have the jumping-off problem due to a step motion detaping operation and the packaged part lost or position misplaced.

Figure 4 shows a cover tape structure according to the US Pat. No. 3,143,208. The cover tape has intersected lines of perforations arranged along the longitudinal direction as well as the transverse direction. This design enables the user to peel off the tape at the desired location along the selected lines of perforations. However, serrated edges are left at the border when the cover tape is peeled off from the bonded carrier tape.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide a composite cover tape for encasing so that an excellent adhesion exists at the sealed site of the cover tape and the sealed object.

It is therefore another object of the invention to provide a composite cover tape for encasing so that a torn strip portion can be peeled from the cover tape smoothly without causing a vibration to the carrier tape in forcing the encased parts jumping out of place. Further, because of the guidance of stress concentration zone and tearing direction can be maintained in course.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features, and advantages of the invention will become apparent from the following detailed description of the preferred but non-limiting embodiments. The description is made with reference to the accompanying drawings in which:

Figure 1-1 is a cross-sectional view showing a conventional cover tape bonded to a carrier tape;

Figure 1-2 is a cross-sectional view showing a state of the cover tape of Figure 1-1 where the cover tape has been bonded to the carrier tape and then peeled off therefrom;

Figure 2-1 is a cross-sectional view showing another structure of a conventional cover tape bonded to a carrier tape;

Figure 2-2 is a cross-sectional view showing a state of the conventional cover tape of Figure 2-1 where the cover tape has been bonded to the carrier tape and then peeled off therefrom;

Figure 3 is a cross-sectional view showing still another structure of a conventional cover tape bonded to a carrier tape;

Figure 4 is a top view showing a conventional cover tape;

Figure 5 is a 3-dimentional view of a composite cover tape according to a first preferred embodiment of the invention;

Figure 6-1 is a cross-sectional view showing a composite cover tape bonded to a carrier tape according to the first preferred embodiment of the invention;

Figure 6-2 is a cross-sectional view showing a state of the composite cover tape of Figure 6-1 where the composite cover tape has been bonded to the carrier tape and then peeled off therefrom according to the first preferred embodiment of the invention;

Figure 7 is a cross-sectional view showing different forces as the cover tape has been peeled off according to the first preferred embodiment of the invention;

Figure 8 is a cross-sectional view showing a composite cover tape bonded to a carrier tape according to another preferred embodiment of the invention;

Figure 9 is a cross-sectional view showing a composite cover tape bonded to a carrier tape according to still another preferred embodiment of the invention;

Figure 10 is a cross-sectional view showing a composite cover tape bonded to a carrier tape according to a further preferred embodiment of the invention;

Figure 11 is a cross-sectional view showing a composite cover tape bonded to a carrier tape according to a still further preferred embodiment of the invention;

Referring to Figure 5, a three-dimensional configuration according to a preferred embodiment of the invention is shown, which includes a composite cover tape 1 and a carrier tape 6. The encased electrical device is posited in the recess of the carrier tape 6. The composite cover tape 1 is a multi-layer tape. The outer layer of the composite cover tape is a release coating layer 11 and the layer adjacent to the release coating layer 11 is an embossed layer 12. The embossed layer 12 is an extended polymeric film made from, for example, nylon, polyethylene terephthalate (PET), polypropylene (PP), polystyrene (PS), polycarbonate (PC), polysulfone, polyimide (PI), polyethylene naphthalate (PEN), polyvinyl chloride (PVC), polypropylene synthetic paper, polyethylene terephthalate synthetic paper. Preferrably, the embossed layer 12 has randomly arranged holes on its surface, which can be processed by an embossing roller. The embossing roller surface is coated with the numerous outward sharpen tips throughout the whole cylindrical surface. At an opposite side of the randomly embossed layer 12, there are provided with an adhesive layer 13 and a non-adhesive layer 14 over the adhesive layer 13. The non-adhesive layer 14 has one side adhered to the adhesive layer 13, and an opposite side preferrably processed by metal vapor deposition or coated with a layer of antistatic agent.

In order to prevent the static charge impact damage imposed on the packed components, the release coating layer 11 may be coated with either an antistatic agent or charge dissipation media or the like. The way of charge dissipation or eliminating static charge can be achieved subject to: (1) using ionic and non-ionic surfactant through internal blending or external coating; (2) using conductive material, such as carbon black powder, graphite fiber powder or metal powder blended material; (3) metal vapor deposition or coating of conductive material, for example, aluminum vapor deposition or coating of intrinsically conductive polyaniline lacquers. Preferrably, the release coating layer 11 is coated by antistatic surfactant coating, radiation cured printing coating and conductive lacquer coating, metal vapor deposition, and metal thin film. Antistatic coating or conductive coating can be a characteristic of the surface resistivity less than 10E13 ohms per square. Material for the randomly embossed layer 12 is preferrably transparent and have the suitable mechanical strength, and a thickness of about 6-150 microns. The randomly embossed layer 12 and the non-adhesive layer 14 can be processed through the flame treatment, plasma treatment or corona discharge, or coated with a primer, so as to enhance their surface adhesion strength. The adhesive layer can be made by the pressure-sensitive adhesives, heat sealable material, the major component of which is preferrably pressure sensitive adhesive or thermoplastics. Suitable materials for the adhesive layer include acrylic adhesives, silicon elastomers, natural or synthetic rubbers, hot melt elastomers, thermoplastics, etc. The adhesive can be formulated either in waterborne or solvent bases. Material for the non-adhesive layer 14 can be obtained from a normal polymeric layer or a extended film such as nylon, polyethylene terephthalate (PET), polyester, polypropylene (PP), polycarbonate (PC), polystyrene (PS), polysulfone, polyimide (PI), polyethylene naphthalate (PEN), polypropylene synthetic

paper, polyvinyl chloride (PVC), PP synthetic paper, and polyethylene terephthalate synthetic paper. The material of the non-adhesive layer 14 has certain mechanical strength, and can be transparent or translucent. The thickness of the material used is subject to actual requirement. Further, the non-adhesive layer 14 can be made by lacquer printing and then through either thermal cure or radiation cure. Preferrably, the non-adhesive layer 14 includes a number of non-adhesive strips the non-adhesive layer includes a number of non-adhesive strips and the non-adhesive strips are spaced from one another. Alternatively, the non-adhesive layer can be divided into a number of non-adhesive zones to fit the shape and size of the carrier tape or carrier tray.

Figures 6-1 and 6-2 are a bonded view in section and a torn-off view in section of the tape shown in Figure 5. In the bonded view, the composite cover tape 1 is divided into a torn strip portion 121, an adhesion portion 122, and a stress concentration zone 123. When the composite cover tape 1 and the carrier tape 6 are fastened together by pressing, heat sealing or any other sealing methods, the adhesion portion 122 with the randomly embossed layer 12 is bonded to the carrier tape 6 having an enhanced mechanical tensile strength. The center portion of the randomly embossed layer 12 is adhered to the non-adhesive layer 14 by the adhesive layer 13 to form a compound film having a higher mechanical tensile strength. The stress concentration zone 123 is disposed between the carrier tape 6 and the non-adhesive layer 14 at the border area. In other words, the stress concentration zone 123 is the junction between the torn strip portion 121 and the adhesion portion 122. Because the stress concentration zone 123 is_mainly_formed by the randomly embossed layer 12, its mechanical tensile strength is the weakest in comparison with the mechanical tearing strength of adhesion portion 122 and the central portion of the composite cover tape 1 containing the randomly embossed layer 12 and the non-

paper, polyvinyl chloride (PVC), PP synthetic paper, and polyethylene terephthalate synthetic paper. The material of the non-adhesive layer 14 has certain mechanical strength, and can be transparent or translucent. The thickness of the material used is subject to actual requirement. Further, the non-adhesive layer 14 can be made by lacquer printing and then through either thermal cure or radiation cure. Preferrably, the non-adhesive layer 14 includes a number of non-adhesive strips the non-adhesive layer includes a number of non-adhesive strips and the non-adhesive strips are spaced from one another. Alternatively, the non-adhesive layer can be divided into a number of non-adhesive zones to fit the shape and size of the carrier tape or carrier tray.

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adhesive layer 14. Numerous randomly embossed holes throughout the surface of the randomly embossed layer 12 has a function of guiding the tearing stress along the stress concentration zone 123 so that rather small tearing force is needed to tear the tape. In other words, the minimum tearing force applied to peel off the torn strip portion 121 from the adhesion portion 122 is smaller than the adhesion force of the adhesion portion 122 to the carrier tape 6 and the adhesion force of the center portion of the randomly embossed layer 12 to the non-adhesive layer 14. It is shown that the tear line is extremely smooth and uniform tearing when peeling the torn strip portion 121 of the cover tape 1 from the adhesion portion 122 of the carrier tape 6.

Referring to Figure 7, as the torn strip portion 121 is peeled off, the tear line has a predetermined direction along the stress concentration zone 123. The position of tear line is highly dependent upon the level of the tearing force, the tearing speed and the ratio of applied tearing force 71, to adhesion forces 72 and 73, wherein the adhesion force 72 is the cohesive strength between the embossed layer 12 and the non-adhesive layer 14 via the adhesive layer 13 and the adhesion force 73 is the cohesive strength between the embossed layer 12 and the top surface of the carrier tape 6 via the adhesive layer 13.

Table 1 shows a peeling adhesion force test made on a embossed biaxially extended polypropylene adhesive tape having a thickness of 29 micrometers and a width of one inch (2.54cm) relative to different adherend materials at different peeling angles:

A\F	SS	PSC	PCC	SS	PSC	PCC
90	769	1061	881	895	895	1295
120	760	724	683	769	675	901
150	616	576	648	630	598	809
170	395	485	496	520	469	679
180	1090	1024	923	1093	1297	1037

Table 1

The embossed biaxially extended polypropylene adhesive tape used in the aforesaid test is obtained from a one inch (2.54cm) wide embossed biaxially extended polypropylene film having one side coated with a pressure-sensitive layer of acrylic adhesive having a thickness of 20 micrometers. In Table 1, A: peeling angle (degree); F: Adhesion force (grams/inch) (1 gram/inch being equivalent to 0.394 grams/cm); SS: stainless steel sheet; PSC: polystyrene plate blended with conductive carbon black; PCC: polycarbonate plate blended with conductive carbon black.

In another example, the embossed biaxially extended polypropylene tape having a width of one inch (2.54cm) and a thickness of 29 micrometers is laminated with a biaxially extended polyester film on the adhesive coated side in the middle, which has a width of 0.5 inch (1.27cm) and a thickness of 25 micrometers. The adhesive tape is respectively adhered to the stainless steel plate and the carbon powder blended polystyrene plate. During the peeling test, torn strip portion is peeled off from the adhesion portion at a peeling angle of 180° and a tearing speed of 24 inches/minute (60.96 cm/minute), and then the tearing forces are measured

respectively. Both tearing forces show the same result at a tearing force of 24 grams. The tearing force, which is directly proportional to the tearing speed and the tearing line, becomes closer to the two opposite lateral sides of the non-adhesive layer when the tearing speed is increased. The stress concentration effect becomes enhanced when the tearing speed is increased, causing the edge of the embossed film to be sharpened along the tearing lines within the stress concentration zone.

Table 2 shows a back peeling adhesion test made on the different thickness of the embossed biaxially extended polypropylene (PP) and polyethylene terephthalate adhesive tapes against a polyethylene terephthalate (PET) film having a thickness of 25 micrometers and a width of one inch (2.54cm) at a tearing speed of 24 inches per minute (60.96 cm/minute):

Embossed biaxially extended polymeric films	KFOPP	KFOPP	KFOPP	KFPET
Thickness (micrometers)	20	29	40	12
Back adhesion force	1146	1033	1091	1463

Table 2

In Table 2, KFOPP and KFPET stand for the embossed biaxially extended polypropylene and polyethylene terephthalate films respectively.

Table 3 shows a applied tearing force test in which one inch wide embossed biaxially extended polypropylene (PP) and polyethylene terephthalate (PET) tapes which have different thickness are respectively adhered with a biaxially extended polyester film having a width of 0.5 (1.27cm) inch and a thickness of 25 micrometers in the middle at one side. The compound adhesive tape is then adhered to a standard stainless steel plate, and the

torn strip portion is peeled off along the stress concentration zones at a peeling angle of 180° and a peeling speed of 24 inches/minute (60.96 cm/minute). The applied tearing force from above tapes is measured.

Embossed biaxially extended polymeric films	KFOPP	KFOPP	KFOPP	KFPET
Thickness (micrometers)	20	29	40	12
Tear force (g/inch)	11	24	28	14

Table 3

According to the aforesaid Table 1, Table 2 and Table 3, the present invention is not limited to a particular adhesive material; the tearing force needed to tear off the randomly embossed layer 12 is about 10 to 50 grams only which is smaller than the adhesion strength among layers of the torn strip portion and the adhesion strength between the embossed film and the adhered object (the carrier tape 6). This applied tearing force is far less than the adhesion strength of the embossed film against the carrier tape and the laminated non-adhesive film. It is not necessary to limit the adhesion force, and torn strip portion can be positively separated from the carrier tape 6 along the stress concentration zones 123. Because the applied tearing force needed to separate the torn strip portion 121 from the cover tape 1 at different angles is small, the torn strip portion 121 can be separated from the cover tape 1 smoothly without causing a vibration to the carrier tape 6 in forcing the encased parts jumping out of place. Further, because of the guidance of stress concentration zone, and tearing direction can be maintained in course.

Figure 8 shows an alternative form of the cover tape 1 adapted to seal a two dimensional carrier tray 5 having recesses 51 of different shapes and depths for encasing

the electronic parts. The carrier tray 5 can be made from paper, synthetic paper, plastics, ceramics, metal or non-metal materials, or mixture of the aforesaid materials, or recycled materials from the aforesaid materials. The cover tape 1 may be processed through surface ink printing to indicate a company name, a trade name, a product name, a identification bar code, etc., for recognition by users or automatic recognition apparatus.

Referring to Figure 9, it is a cross section of a further form of the present invention. The structure includes a composite cover tape 2 and a carrier tape 6. The electronic parts 9 for encasing are posited in the recesses of the carrier tape 6. The composite cover tape 2 is a multi-layer tape. The outer layer of the composite cover tape is a release coating layer 21 and the layer adjacent to the release coating layer 21 is an uniaxially extended film 22. The release coating layer 21 can be coated by drying, thermal cure, and radiation cure. The uniaxially extended film 22 is an uniaxially extended polymeric film made from, for example, nylon, polyvinyl alcohol (PVA), polyester, polypropylene (PP), polycarbonate (PC), polystyrene (PS), polysulfone, polyimide (PI), polyethylene naphthalate (PEN), PP synthetic paper, polyvinyl chloride (PVC), polypropylene synthetic paper, and polyethylene terephthalate synthetic paper. On another side of the uniaxially extended film 22 opposite to the release coating 21, an adhesive zone coating 24 with parallel intervals is provided along the extending direction of the uniaxially extended film 22. The adhesive of the adhesive zone coating 24 can be either pressure-sensitive adhesives or heat sealable thermoplastics. In addition to the zone coating of the uniaxially extended film 22, the adhesive layer can be coated throughout the whole surface if heat sealable elastomer is utilized.

The material of the uniaxially extended film 22 is highly extended in a particular direction. From microstructure point of view, a parallel fibrous structure is shown at the uniaxially extended film 22, therefore the uniaxially extended film 22 has a high mechanical tensile strength in its material extending direction. On the contrary, the mechanical tensile strength of the uniaxially extended film 22 in the direction perpendicular to its material extending direction, i.e. transverse direction, is weak. Therefore, when employing a tearing force to a cut made at one side edge of the uniaxially extended film 22 in its material extending direction, the uniaxially extended film 22 can be easily broken at the stress concentration area along the direction of the cut. Preferrably, the extended direction of the uniaxially extended layer is designed to be parallel to an extended direction of the carrier tape. The tearing is extremely smooth and uniform, and the two opposite side edges of the torn strip portion are maintained smooth when detached from the cover tape 5, because the parallel fibrous structure of the uniaxially extended film 22 guides the concentration of the stress of the tearing force. Little vibration is produced to force the encased electronic parts out of the recesses of the carrier tape 6 because the torn strip portion can be smoothly detached from the cover tape 5. Further, because there is a stress concentration zone designed to guide the tearing, the tearing direction is maintained in course when detaching the torn strip portion.

In some circumstances, when the cover tape is used in a high temperature environment, the cover tape is also preferably processed to have anti-static treatment or charge-dissipation properties. An anti-static layer 23 can be formed, by coating or metal vapor deposition, between the uniaxially extended film 22 and the adhesive zone coating 24, which can be achieved by performing an antistatic treatment. The way of charge dissipation or eliminating static charge can be achieved subject to : (1) using ionic and

non-ionic surfactant through internal blending or external coating; (2) using carbon black powder, graphite fiber powder or metal power blended material; (3) metal vapor deposition or coating of conductive material, for example, aluminum vapor deposition or coating of intrinsically conductive polyaniline lacquers. Antistatic coating or conductive coating can be a characteristic of the surface resistivity less than 10E13 ohms per square.

In actual practice, it is preferred that blending permanent antistatic agent with the material of the uniaxially extended film 22 to simplify the process and reduce the cost. The surface of the uniaxially extended film 22 can be processed through the flame treatment, plasma treatment or corona discharge, or coated with a primer, so as to enhance the surface adhesion strength between the uniaxially extended film layer 22 and the adhesive zone coating 24. The adhesive zone coating 24 is not limited to any certain adhesive material but depended on the layer it adhered to so that the adhesive zone coating can be made by the pressure-sensitive adhesives, heat sealable material, the major component of which is preferrably pressure sensitive adhesive or thermoplastics. Suitable materials for the adhesive layer include acrylic adhesives, cyanoacrylate adhesives, polyurethane adhesives, unsaturated polyester adhesives, silicon elastomers, natural or synthetic rubbers, hot melt elastomers, thermoplastics, etc. The adhesive can be formulated either in waterborne, solvent or solventless bases, and treated to a dry state by thermal, radiation or electron beam.

Referring to Figure 10, which shows a composite cover tape according to a further preferred embodiment of the present invention, the composite cover tape 3 is a multi-layer structure. The composite cover tape 3 includes a release coating 21 at its outer side, and an uniaxially extended film layer 22 adjacent to the release coating 21. The release

coating layer 21 can be coated by drying, thermal cure, and radiation cure. The uniaxially extended film 22 is an uniaxially extended polymeric film made from, for example, nylon, polyvinyl alcohol (PVA), polyester, polypropylene (PP), polycarbonate (PC), polystyrene (PS), polysulfone, polyimide (PI), polyethylene naphthalate (PEN), polypropylene synthetic paper, polyvinyl chloride (PVC), and polyethylene terephthalate synthetic paper. On another side of the uniaxially extended film 22 opposite to the release coating 21, a heat sealable adhesive layer 33 is provided. The heat sealable adhesive layer 33 is made from hot melt elastomers or thermoplastics having a high glass transition temperature. This heat sealable adhesive layer 33 is not sticky at room temperature. When the electronic parts are sealed in a the recesses on the carrier tape or the carrier tray, the composite cover tape 1 is brought and heat sealed to two parallel side edges of the recesses of the carrier tape or the carrier tape through the heat sealable adhesive layer 33, forming with the surface of the bonded object (the carrier tape) a strong bonding strength interface. The heat sealable adhesive layer 33 may be added with an antistatic agent, so as to provide an antistatic property for protecting the active integrated components of the encased electronic parts against impact. When the electronic parts 9 is taken from the carrier tape 6, the torn strip portion on the middle of the composite cover tape 3 between its two bonded side edges can be removed by tearing. In order to ensure a positive tearing, cuts may be provided at the front edge of the composite cover tape 3 at the boundary lines, so that the torn strip portion which coves over the recesses of the carrier tape 6 can be positively detached from the composite cover tape 3. The tearing is extremely smooth and uniform, and the two opposite side edges of the torn strip portion are maintained smooth when detached from the composite cover tape 7, because the parallel fibrous structure of the uniaxially extended film layer 33 guides the concentration

of the stress of the tearing force. Little vibration is produced to force the encased electronic parts out of the recesses of the carrier tape 6, because the torn strip portion can be smoothly detached from the composite cover tape 7. Further, the tearing direction is maintained in course when detaching the torn strip portion because there is a stress concentration zone produced to guide the tearing.

As the composite cover tape for encasing is utilized in a high temperature environment such as the baking process prior to device packaging, a composite cover tape according to another preferred embodiment as shown in Figure 11 is disclosed for preventing the heat sealable pressure sensitive layer 33 from softening. On the center of the torn strip portion of the composite cover tape 3 near the electrical devices, a non-adhesive layer 42 is adhered by a second adhesive layer 41. Alternatively, the non-adhesive layer 42 can be designed and adhered to the outer layer of the torn strip portion far away from the carrier object by the second adhesive layer 41. The material of non-adhesive layer 42 can be an extended polymer, such as nylon, polyvinyl alcohol (PVA), polyethylene terephthalate (PET), polyester, polypropylene (PP), polycarbonate (PC), polystyrene (PS), polysulfone, polyimide (PI), polyethylene naphthalate (PEN), polyvinyl chloride (PVC), polypropylene synthetic paper, and polyethylene terephthalate synthetic paper.

In some particular circumstances, the side of the cover tape adjacent the adjacent object is preferrably further processed to have anti-static treatment or charge-dissipation properties. An anti-static layer 43 can be formed, by coating or metal vapor deposition, on the surface of the non-adhesive layer 42. The way of charge dissipation or eliminating static charge can be achieved subject to : (1) using ionic and non-ionic surfactant through

internal blending or external coating; (2) using carbon black powder, graphite fiber powder or metal power blended material; (3) metal vapor deposition or coating of conductive material, for example, aluminum vapor deposition or coating of intrinsically conductive polyaniline lacquers. Preferrably, the antistatic coating can be coated by one of the antistatic surfactant coating, radiation cured printing coating and conductive lacquer coating, metal vapor deposition, and metal thin film. Antistatic coating or conductive coating can be a characteristic of the surface resistivity less than 10E13 ohms per square.

The cover tape can also be adapted to seal a two-dimensional carrier tray having recesses of different shapes and depths for encasing the electronic parts. The carrier tray can be made from paper, synthetic paper, plastics, ceramics, metal or non-metal materials, or mixture of the aforesaid materials, or recycled materials from the aforesaid materials.

It is to be understood that the drawings are designed for purposes of illustration only, and are not intended as a definition of the limits and scope of the invention disclosed.

The present invention is a divisional application, related to parent United Kingdom patent application number 9803510.8. The parent application as originally filed included the following claims, the subject matter of which is relevant to the present divisional application.

1. A composite cover tape for encasing electronic parts in a carrier object, comprising:

an adhesive layer;

a non-adhesive layer; and

an embossed layer having a plurality of randomly arranged holes, wherein the adhesive layer is on one surface of the embossed layer and the non-adhesive layer is adhered to center of the embossed layer by the adhesive layer, wherein the composite cover tape comprises:

an adhesion portion, which is a portion of the composite cover tape adhering to the carrier object by the adhesive layer;

a torn strip portion which is a portion of the composite cover tape adapted to enhance cohesive strength of the embossed layer by compounding the non-adhesive layer; and

a stress concentration zone which is a junction of the adhesion portion and the torn strip portion;

Wherein the torn strip portion is peeled off along the stress concentration zone with an applied tearing force before removing the encased electronic parts from the carrier object.

2. The composite cover tape of claim 1, wherein the applied tearing force for peeling off the torn strip portion is smaller than an adhesion force of the adhesive layer for adhering the adhesion portion of the composite cover layer to the carrier object.

3. The composite cover tape of claim 1, wherein the applied tearing force for peeling off the torn strip portion is smaller than a cohesion force of the torn strip portion mainly contributed by the adhesive layer.

4. The composite cover tape of claim 1, wherein the embossed layer is made from a material selected from an extended polymer group consisting of nylon, polyethylene terephthalate (PET), polypropylene (PP), polystyrene (PS), polycarbonate (PC), polysulfone, polyimide (PI), polyethylene naphthalate (PEN), polyvinyl chloride (PVC), polypropylene synthetic paper, and polyethylene terephthalate synthetic paper.

5. The composite cover tape of claim 1, wherein the embossed layer is an uniaxially extended layer, the carrier object is a carrier tape and the extended direction of the uniaxially extended layer is parallel to an extended direction of the carrier tape.

6. The composite cover tape of claim 5, wherein the extended layer is made from a material selected from an uniaxially extended polymer group consisting of nylon, polyvinyl alcohol (PVA), polyester, polypropylene (PP), polycarbonate (PC), polystyrene (PS), polysulfone, polyimide (PI), polyethylene naphthalate (PEN), polyvinyl chloride (PVC), polypropylene synthetic paper, and polyethylene terephthalate synthetic paper.

7. The composite cover tape of claim 1, wherein the non-adhesive layer is made from a material selected from a polymer group consisting of nylon, polyethylene terephthalate (PET), polyester, polypropylene (PP), polycarbonate (PC), polystyrene (PS), polysulfone, polyimide (PI), polyethylene naphthalate (PEN), polyvinyl chloride (PVC), polypropylene synthetic paper, and polyethylene terephthalate synthetic paper.

8. The composite cover tape of claim 1, wherein the non-adhesive layer includes a conductive metal thin film.

9. The composite cover tape of claim 1, wherein the non-adhesive layer includes a plurality of non-adhesive strips.

10. The composite cover tape of claim 9, wherein the non-adhesive strips are spaced from one another.

11. The composite cover tape of claim 1, wherein the non-adhesive layer is divided into a plurality of non-adhesive zones to fit the shape and size of the carrier object.

12. The composite cover tape of claim 1, wherein the non-adhesive layer is adhered to a surface of the torn strip portion adjacent to the carrier object.

13. The composite cover tape of claim 1, wherein the non-adhesive layer is adhered to the outer layer of the torn strip portion far away from the carrier object by a second adhesive layer.

14. The composite cover tape of claim 13, wherein the second adhesive layer is a pressure sensitive adhesive layer.

15. The composite cover tape of claim 1, wherein a release layer is coated on a surface of the embossed layer opposite to the adhesive layer.

16. The composite cover tape of claim 15, wherein the release layer is processed through a technique selected from a group consisting of drying, thermal cure, and radiation cure.

17. The composite cover tape of claim 1, wherein the non-adhesive layer has one side which faces the encased electronic parts coated with an antistatic coating layer.

18. The composite cover tape of claim 17, wherein the antistatic coating layer is surfaced by a process selected from the group consisting of antistatic surfactant coating, radiation cured printing coating and conductive lacquer coating, metal vapor deposition, and metal thin film.

19. The composite cover tape of claim 1, wherein the surface of the embossed film to the adhesive layer is processed through a process selected from a group consisting of flame treatment, plasma treatment, corona discharge, and primer coating to enhance surface adhesion strength.

Claims:

1. A composite cover tape for encasing electronic parts in a carrier object, comprising:

an adhesive layer; and

an uniaxially extended layer, wherein the adhesive layer is adhered to a surface of the uniaxially extended layer adjacent to the carrier object, wherein the composite cover tape comprises:

an adhesion portion, which is a portion of the composite cover tape adhering to the carrier object by the adhesive layer;

a torn strip portion which is a portion of the composite cover tape, not adhering to the carrier object; and

a stress concentration zone which is a junction of the adhesion portion the torn strip portion;

wherein the torn strip portion is peeled off along the stress concentration zone with an applied tearing force before removing the encased electronic parts from the carrier object.

2. The composite cover tape of claim 1, wherein the applied tearing force for peeling of the torn strip portion is smaller than an adhesion force of the adhesive layer for adhering the adhesion portion of the composite cover layer to the carrier object.

3. The composite cover tape of claim 1, wherein the applied tearing force for

peeling off the torn strip portion is smaller than a tearing force required to tear the uniaxially extended layer in a transverse direction, perpendicular to the extending direction of the uniaxially extended layer.

4. The composite cover tape of claim 1, wherein a release layer is coated on a surface of the uniaxially extended layer opposite to the adhesive layer.

5. The composite cover tape of claim 4, wherein the release layer is processed through a technique selected from a group consisting of drying, thermal cure, and radiation cure.

6. The composite cover tape of claim 1, wherein an antistatic layer is coated on another surface of the uniaxially extended layer opposite to the adhesive layer.

7. The composite cover tape of claim 1, wherein the antistatic coating layer is surfaced by a process selected from the group consisting of antistatic surfactant coating, radiation cured printing coating and conductive lacquer coating, and metal vapor deposition.

8. The composite cover tape of claim 1, wherein a printing layer is coated on another surface of the uniaxially extended layer opposite to the adhesive layer.

9. The composite cover tape of claim 1, wherein the uniaxially extended

layer is made from a material selected from an uniaxially extended polymer group consisting of nylon, polyvinyl alcohol (PVA), polyethylene terephthalate (PET), polypropylene (PP), polycarbonate (PC), polystyrene (PS), polysulfone, polyimide (PI), polyethylene naphthalate (PEN), polyvinyl chloride (PVC), polypropylene synthetic paper, and polyethylene terephthalate synthetic paper.

10. The composite cover tape of claim 9, wherein the uniaxially extended layer has a surface resistivity less than 10E13 ohms per square.

11. The composite cover tape of claim 1, wherein the adhesive layer is a adhesive zone coating.

12. The composite cover tape of claim 11, wherein the adhesive zone coating is a pressure sensitive adhesive layer.

13. The composite cover tape of claim 11, wherein the adhesive zone coating is a heat sealable elastomer layer.

14. The composite cover tape of claim 1, wherein an antistatic layer is formed on the surface of the uniaxially extended layer adjacent to the carrier object.

15. The composite cover tape of claim 11, wherein the antistatic coating layer

is surfaced by a process selected from the group consisting of antistatic surfactant coating, radiation cured printing coating and conductive lacquer coating, and metal vapor deposition.

16. The composite cover tape of claim 1, wherein the adhesive layer is a heat sealable adhesive layer.

17. The composite cover tape of claim 16, wherein the heat sealable adhesive layer has a surface resistivity less than 10E13 ohms per square.

18. The composite cover tape of claim 1, wherein an non-adhesive layer is positioned on a surface of the torn strip portion adjacent to the carrier object.

19. The composite cover tape of claim 18, wherein the non-adhesive layer is adhered to the torn strip portion by a second adhesive layer.

20. The composite cover tape of claim 19, wherein the second adhesive layer is a pressure sensitive layer.

21. The composite cover tape of claim 18, wherein the non-adhesive layer is made from a material selected from a polymer group consisting of nylon, polyvinyl alcohol (PVA), polyethylene terephthalate (PET), polypropylene (PP), polycarbonate (PC), polystyrene (PS), polysulfone, polyimide (PI), polyethylene naphthalate (PEN),

polyvinyl chloride (PVC), polypropylene synthetic paper, and polyethylene terephthlatae synthetic paper.

22. A composite cover tape for encasing electronic parts, substantially as hereinbefore described with reference to and/or as illustrated in any one of or any combination of Figs. 5 – 11 of the accompanying drawings.

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Application No:	GB 0004056.8	**Examiner:**	Michael Logan
Claims searched:	1-22 (on pages 28-32)	**Date of search:**	22 May 2000

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B8C (CHA1, CHS4, CHS5)

Int Cl (Ed.7): B65D 73/02, B32B, C09J 7/02, H05K 13/00

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	WO 94/00971 A1 (MINNESOTA MINING) see especially page 9, lines 23-26	1-3,6,7,9, 11-16,18

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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